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CALIBRATION AND ADJUSTMENT MANUAL

FOR RAPID PERFORMANCE TEST SEE ADDENDUM

707 SPECTRUM ANALYZER

REVISION A

AILTECH
A CUTLER-HAMMER COMPANY
FARMINGDALE, NEW YORK 11735
CONTROL

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HARRIS TECHNICAL
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NORFOLK, VA

CALIBRATION AND ADJUSTMENT MANUAL

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FOREWORD

The AILTECH 707 Spectrum Analyzer handbook information is divided into three applicable manuals. These are:

OPERATING MANUAL

Contains general information relating to the operational characteristics of the instrument.

CALIBRATION AND ADJUSTMENT MANUAL

Contains front panel checkout procedures, detailed calibration procedures, and alignment instructions.

SERVICE MANUAL

Contains all information required to service and maintain the instrument. Includes schematic diagrams, troubleshooting procedures, and replaceable parts list.

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AILTECH 707 SPECTRUM ANALYZER

SECTION I
GENERAL INFORMATION

1-1. SCOPE

This manual provides calibration and adjustment procedures for the AILTECH 707 Spectrum Analyzer. Separate manuals are provided for Operation and for Service of the Spectrum Analyzer as is explained in the Foreword.

1-2. GENERAL

The procedures presented in this manual will aid the user in determining if the instrument is operating properly and in aligning the instrument for optimal performance.

The procedures should be scheduled on a periodic basis. If a system malfunction is discovered while performing these procedures, refer to Chapter 3 of the Service Manual for fault isolation procedures.

NOTE

The user should be familiar with the operating procedures presented in the Operating Manual before attempting to calibrate or adjust the instrument.

1-3. PROCEDURES

The procedures contained herein are presented in three sections. Section II provides the system performance check for the AILTECH 707; Section III contains those procedures used for periodic system calibration and adjustment; and Section IV contains subsystem performance checks.

SECTION II
SYSTEM PERFORMANCE CHECK

This section presents a sequence of checks on the AILTECH 707 Spectrum Analyzer designed to verify the performance of the instrument. All checks are performed using the front panel operating controls. Figure 2-1 shows the identification of the front panel controls and indicators.

2-1. INITIAL TURN ON

Set the POWER switch (24, Figure 2-1) to the on position and note that the following occurs: (1) the blower motor starts with an audible sound; (2) the MHz light emitting diode readout (1, Figure 2-1) illuminates indicating a number denoting the frequency at the center of the screen; (3) a low hum is generated by the 3-kHz chopper in the high voltage power supply. After a short warmup (2 to 10 seconds), the cathode ray tube will illuminate and noise, and possibly signals, should be present.

2-2. INITIAL CONTROL SETTINGS

Set the switches and controls as follows to obtain normal presentation:

SCAN MODE (16)*	AUTO
SCAN WIDTH/cm (14)	200 MHz
SCAN WIDTH/cm vernier (15)	CAL (Fully clockwise)
SCAN TIME/cm (12)	3 msec
SCAN TIME/cm vernier (13)	CAL (Fully clockwise)

* The number in parentheses indicates the reference number from Figure 2-1.

10 BANDWIDTHS (kHz) I. F. switch

Five-position switch manually selects IF bandwidths of 1, 10, 100, and 1000 kHz or, in the AUTO position, the analyzer automatically selects the best available IF bandwidth for the combination of SCAN TIME/cm and SCAN WIDTH/cm in use.

11 BANDWIDTHS (kHz) VIDEO switch

Three-position switch, concentric with the BANDWIDTHS, (kHz) I. F. switch for manual selection of the video bandwidths of 0. 5 and 1000 kHz or, in the AUTO position, the analyzer automatically selects the best available video bandwidth for the IF bandwidth in use.

12 SCAN TIME/cm switch

Nine-position switch selects six calibrated scan times from 3 to 1000 msec/cm in a 1, 3, 10 sequence or, three calibrated sweep times of 10, 100, and 1000 μsec/cm for zero scan width (time domain) displays.

13 SCAN TIME/cm vernier

Concentric control for interpolation. Scan or sweep times are calibrated when the vernier is fully clockwise.

14 SCAN WIDTH/cm switch

Fourteen-position switch selects calibrated scan widths from 1 kHz to 100 MHz/cm in a 1, 3, 10 sequence and 200, 500, and 700 MHz/cm.

15 SCAN WIDTH/cm vernier

Concentric control continuously adjusts scan width from zero to the setting of the SCAN WIDTH/cm switch. Scan widths are calibrated when the vernier is fully clockwise.

16 SCAN MODE switch

Six-position switch selects trigger mode for internal scan or an external sweep signal as follows:

AUTO:	Recurrent scan, internally generated
LINE:	Scan triggered by the ac line
VIDEO:	Scan triggered by the detected RF input signal
EXT TRIG:	Scan triggered by an external +2 volt minimum signal
SINGLE:	Single scan initiated by concentric SINGLE SCAN pushbutton switch (17).
EXT SWEEP:	Requires external 0 to +6 volts signal for 10 cm, left-to-right horizontal deflection.

17 SINGLE SCAN switch

Pushbutton concentric with SCAN MODE switch (16) initiates single scan.

18 BASELINE control

Adjusts baseline clipping level.

19 CONTRAST control

Adjusts intensity of the clipped portion of the display.

20 HOR POS control

Screwdriver control for horizontal position adjustment.

21 VERT POS control

Screwdriver control for vertical position adjustment.

22 INTENSITY control

Adjusts brightness of the CRT display.

23 SCALE control

Adjusts the brightness of the graticule lines.

24 POWER switch

On-off switch for primary power.

FIGURE 2-1. FRONT PANEL CONTROLS AND INDICATORS

BANDWIDTHS (kHz)	
I. F. (10)	AUTO
VIDEO (11)	AUTO
AMPLITUDE RANGE (9)	10 LOG (dB/cm)
R. F. ATTEN (dB) (7)	10
I. F. ATTEN (dB) (6)	10
R. F. RANGE (GHz) (4)	0.001 - 2.0
FULL RANGE (5)	OFF
SIGNAL CENTER (3)	Indexing dot pointing straight up (centered)

2-3. CONTROL SETTING EXPLANATION

By placing the SCAN MODE switch to AUTO, the analyzer sweep is self synchronous.

By placing the BANDWIDTHS (kHz) I. F. switch to AUTO, the 1-MHz IF filter for the selected scan width and scan time combination is energized. The AUTO setting of the VIDEO control links it with the IF filter selection.

The setting of the R. F. ATTEN (dB) switch limits the amount of power incident into the AILTECH 707 whereas the setting of the I. F. ATTEN (dB) switch normalizes the overall gain of the instrument, which nominally has 10 dB excess gain.

The SIGNAL CENTER control performs very specific functions and is not intended as a fine tuning control.

2-4. DISPLAY ALIGNMENT

To properly align the trace on the screen the HOR POS control and the VERT POS control on the front panel should be adjusted in the following manner:

a. Allow one-half hour for warmup and set the I. F. ATTEN (dB) switch to 100 and the BANDWIDTHS (kHz) I. F. switch to 1.

b. Adjust the HOR POS control so that the sweep starts at the left edge of the graticle.

c. Adjust the VERT POS control to position the trace 2 mm below the 100 dB line. There are two small marks on the graticule which indicate this position.

d. Set the I. F. ATTEN (dB) switch to 10 and the BANDWIDTHS (kHz) I. F. switch to AUTO. The noise presentation on the screen will return to approximately the 70 dB line.

2-5. PERFORMANCE CHECK

NOTE

To acquaint the operators with the proper action of the instrument, the following performance check is not presented in a series of steps. It is explained, not in the manner of what is done, but what happens when a check is performed.

2-6. VIDEO

As the I. F. ATTEN (dB) switch is varied from the 0 position down through its positions, the baseline noise can be seen to vary up to 30 dB. This is a normal occurrence and is a result of inserting attenuation between the different amplifier stages. The source of the displayed noise is the first amplifier with the least attenuation, and this source moves through the amplifier chain until it finally occurs at the log IF with maximum attenuation. The expansion of the baseline on the AMPLITUDE RANGE switch from 10 dB/cm to 2 dB/cm is always around the low portion of the display, that is the 100 dB line. If the noise level is above the 100 dB line when an expansion is

selected, the noise will rise up to the middle, or even the top of the display. If enough attenuation has been inserted in the IF chain to drop the noise level to the 100 dB line, the noise level will remain there when the expansion is selected. If a small scale signal is selected in the 2 dB/cm section, and the LIN (linear) display selected, the signal will be approximately the same amplitude as the 2 dB display and the baseline will be the same.

2-7. TUNING

The TUNING control has several functions. It is a concentric knob with a fine and coarse control mechanically linked together with an approximate 6:1 reduction, thereby achieving good control of tuning at all times. The control actually drives one of two potentiometers located behind the front panel, and they, in turn, control the entire system. The automatic switchover point is set by the SCAN WIDTH/cm switch when it is switched from 1 MHz to 300 kHz. Thus, one of the potentiometers controls the analyzer for its wide dispersion capability, and the other for its narrow dispersion capability. Rotating the control determines the frequency at the center of the screen, and on the display tube the entire noise baseline will move from right to left when this is done. The control also determines the frequency on the digital readout which corresponds to the frequency at the center of the screen.

With the settings of the controls as described, there should be a presentation on the screen of a noise baseline approximately 1 cm high and centered on the 70 dB line, plus or minus a cm. The noise baseline should extend horizontally more than 10 cm and its position on the screen is controlled by the TUNING control. Rotating the TUNING control until the frequency readout reads 1000 MHz should position the baseline such that it occupies a little more than the full screen. The starting point of the baseline should be on the very edge of the etched graticule, whereas the ending point extends a little beyond the right edge. Possibly visible on the left edge

of the presentation at the 0 MHz point is a large signal referred to as "zero beat." If not visible, the analyzer may be tuned to bring it on to the screen, and then tuned to bring it to the center of the screen. By turning the SCAN WIDTH/cm switch step by step down to 10 MHz, while bringing the signal to the center of the screen, it is possible to view it in better detail. As the SCAN WIDTH/cm switch is reduced, the signal should remain at the center of the screen within a cm, so that it will be easy to keep it in view. The signal, which is actually the local oscillator feedthrough in the first mixer, is exactly at 0 MHz reference for the analyzer. This is so because the local oscillator is now tuned to the center of the first IF frequency, and the frequency of the signal on the screen is simply the difference between this local oscillator and the IF.

2-8. DIGITAL FREQUENCY READOUT

The frequency readout should be reading approximately 0 MHz. When the analyzer is tuned below 0, the counter will read very high numbers, starting up in the 99-GHz region, and this is normal. Because YIG devices are utilized in the analyzer, there is a hysteresis effect noticeable on the screen primarily for the frequency accuracy. This effect is simply caused by tuning a magnetic device either from plus to minus, or minus to plus, and results in a natural offset of the device. On the analyzer, hysteresis is noticed by a frequency inaccuracy, of typically 10 MHz or so. To eliminate this inaccuracy, it is required to sweep the YIG devices from a single direction and with a relatively fast speed. This can be done by simply rotating the SCAN WIDTH/cm switch from the present 10 MHz up to approximately 200 MHz, and then back down to the 10 MHz position. This should be done quickly and a resulting small shift of the signal will probably occur. This operation is popularly referred to as degaussing, and centers the frequency readout and the signal on the screen. It should be repeated every time an accurate frequency readout is desired if the TUNING control has been changed.

The "zero beat" indication on the screen should be between 45 and 60 dB above the noise level. If less signal is present it could indicate that the local oscillator signal is weak, thereby losing some sensitivity for other signals. If much more signal is present it could indicate damage to the first mixer, thereby decreasing the local oscillator to IF isolation characteristics.

2-9. SCAN WIDTH CONTROL

Changing the SCAN WIDTH/cm switch from the 10 MHz position to the 3 MHz position causes two effects. One, the IF bandwidth is automatically switched from 1000 kHz to 100 kHz as can be confirmed by rotating the BANDWIDTHS (kHz) I. F. switch to these positions. The second effect is an apparent capacitor charge action, in that the signal that had been on the center of the screen will jump a certain amount and then return toward center. At the 3 MHz/cm position, a capacitor is connected to the main oscillator to increase stability for more detailed analysis. As the SCAN WIDTH/cm switch is switched from 3 MHz back to 10 MHz and then down to 3 MHz, it is noticed that the charge action of the capacitor is made much faster, as would be expected.

2-10. PHASE-LOCK LOOP

When the SCAN WIDTH/cm switch is switched from 1 MHz to 300 kHz, a phase-lock loop system is automatically activated to stabilize the main local oscillator in the analyzer. This oscillator, operating in S-band, is referenced to a crystal controlled comb source which permits a stabilized lock every MHz, when the oscillator is operated in its fundamental mode--that is, when the analyzer is displaying between 0 and 4 GHz. When the analyzer is operating second or third harmonic, the lock possibilities occur at every 2 MHz, or at every 3 MHz. When the actual switch activation is accomplished, the signal on the screen will jump to a lock point, which could occur anywhere on the screen. If the phase lock acquisition is not stable, the signal will appear to have some jitter, or will have sidebands caused by

the loop seeking a stable lock. This can be confirmed or overridden by rotating the SIGNAL CENTER control a small amount. If the phase lock is strong, the signal on the screen will not move with this rotation of the control. If the signal does move, it should jump to a stable lock position and then remain as the control is turned a small amount further. Depressing the SIGNAL CENTER control deactivates part of the phase lock system and permits the oscillator to be moved to adjacent comb lines of the stabilization circuit. These position should be 1 MHz either to the right or the left of the signal, and the signal should actually jump to the spot. If it is possible to walk the signal over to a stable point, phase lock adjustment might be required. It is possible to have a stabilized presentation at other than 1 MHz combinations, and these are caused by harmonics in one of the loop mixers. These are stable positions but do not have the firm stability of the main lock. Selecting the most stable position, or the one closest to the center of the screen, the signal can be moved to the center by rotating the TUNING control. It is now noticed that the TUNING control sensitivity has changed drastically as the second potentiometer has been mechanically energized. This change in resolution permits the tremendous expansion capability of the analyzer from 700 MHz/cm down to 1 kHz/cm. Since the digital readout is connected to the main tuning control, further tuning in the narrow dispersions will not affect the frequency display. The frequency that is displayed is the frequency of the signal that was in the center of the screen when phase lock was activated. An automatic recentering function is included in the analyzer to maintain the fine tuning potentiometer in the middle of its operating mode. This function can be noticed by tuning the unit at 300 kHz/cm, and then switching to 1 MHz/cm and listening for a spring activation. The sound is normal and indicates that the potentiometer has been recentered.

2-11. CRYSTAL FILTER RESPONSE

With the SCAN WIDTH/cm switch set to 300 kHz and the signal centered on the screen, it may be noticed that the filter shape is not the

typical smooth curve, but has apparent spurious responses usually on the left side of the filter shape. These are normal and are characteristic of very wide crystal filters. The filter provides excellent selectivity, as is noticed by its almost 3:1 shape factor from 60 to 3 dB, but does have spurious edges. It is these spurious signals on the edges of the filter shapes that cause the apparent ringing effect when the filter is first selected at 3 MHz/cm. The ringing is apparent approximately 60 dB down from the signal and could be eliminated by changing the SCAN TIME/cm switch to the 10 msec position.

With the signal centered on the screen, switching to 100 kHz/cm again changes the filter bandwidth and selects the 10 kHz bandwidth. Further switching down to 10 kHz/cm causes the final bandwidth switch to occur down to 1 kHz. It might be necessary to recenter the signal as the scan width is decreased since the signal was probably not exactly in the center at the wider dispersions. When the narrowest dispersion has been selected and the signal centered, the signal will remain in the center as the scan width is increased.

With the SCAN WIDTH/cm switch set at 10 kHz and the IF bandwidth automatically selected as 1 kHz (AUTO position), further ringing will be noticed on the display. This ringing is characterized by extra responses on the right side of the signal and is normal. It is due to the fact that we are now scanning 100 kHz in frequency with a 1 kHz filter every 30 ms and are not dwelling long enough in the filter bandwidth to permit a normal charge and discharge action to occur. To eliminate the ringing, the scan time can be slowed down to 10 ms per cm or the 10 kHz IF filter can be selected. But it should be noticed that when this filter is changed to 10 kHz, a large amount of resolution is lost. The auto select function of the IF bandwidth attempts to select the filter with the best resolution capability without losing the amplitude response of the signal. The filters used in the AILTECH 707 Spectrum Analyzer have the characteristic such that they ring before losing amplitude response, thus warning the operator that he has just started to scan

too fast. Scanning wider frequencies with the same bandwidth will result in the amplitude loss.

2-12. AMPLITUDE RANGE

Resetting the SCAN WIDTH/cm switch to 1 kHz, it is noticed that the noise level is up to almost the 50 dB line. At this point it is possible to increase IF attenuation until the peak of the signal is at the 50 dB line and then change the AMPLITUDE RANGE switch to 5 (dB/cm) presenting a 50 dB display on the screen only 10 kHz wide. At this point the residual FM of the signal on the screen should be less than 1/5 of one division, or 200 Hz. By selecting the LINE position on the SCAN MODE switch, it is possible to synchronize the sweep to 60 Hz line frequency and remove that component from the residual FM of the displayed signal.

As pointed out previously, the signal on the screen is exactly the zero frequency marker for the analyzer, and if there were other signals present at very low frequencies, they would be visible to the right of the "zero beat." Typically, signals are displayed at less than 50 kHz in frequency to full amplitude, providing the vast range of 50 kHz to 12 GHz in one unit. The signals to the left of zero frequency are spurious signals and should not be analyzed further. This region is an undefined region for the Spectrum Analyzer.

Increasing the I. F. ATTEN (dB) until the signal goes to the 50 dB graticule with 5 dB/cm, and switching the AMPLITUDE RANGE/cm switch to 2 dB should once again give a full screen presentation of 20 dB. Switching the control to LIN should give nearly the same presentation, since the linear display is approximately 20 dB, but in this mode 10 dB of IF attenuation should drop the signal approximately 2/3 amplitude. When varying the AMPLITUDE RANGE (dB) switch through all of its positions, the noise baseline should stay steady when the narrowest IF bandwidth is being used.

2-13. TIME DOMAIN

Returning the SCAN WIDTH/cm switch to 10 MHz and turning the SCAN TIME/cm switch to the TIME DOMAIN position marked 1000 μsec (1 msec/cm), a time domain presentation should be visible on the screen. Since the signal being displayed is a CW signal, only the characteristic of the amplitude response of the IF filters will be viewed, and when the TUNING control is varied the amplitude will go up and then down the filter shape. When the BANDWIDTHS (kHz) I. F. switch is in its AUTO position the 1 MHz bandwidth is selected when the time domain is activated. If a different bandwidth is desired, it may be manually selected. If amplitude modulation had been present it would be possible to view square waves or pulses, and changing the SCAN MODE/cm switch to VIDEO would synchronize the display on the screen. The triggering level is fixed and thus the amplitude of the signal must be varied to control the presentation.

2-14. GENERAL OPERATION

Returning back to 3 msec on the SCAN TIME/cm switch, setting SCAN WIDTH/cm switch to 200 MHz, and tuning the frequency readout to 1000 MHz we can again see the full zero to 2 GHz presentation. Switching the R. F. RANGE (GHz) switch to the 1.8 - 4.0 position (band 2) the unit now displays all of S-band. The frequency readout will be reading approximately 3000 MHz since the center of the TUNING control corresponds to the center of the selected RF range. The vertical level of the baseline for the second band will decrease approximately 5 dB from that of the first band, and indicates the improved sensitivity achievable in this band. By tuning the analyzer to all the frequencies, while remaining in band 2, it should be noticed that signals below 1.5 GHz are viewable before the trace is blanked. This is normal and very useful since sensitivity and power handling capabilities are improved in band 2 more than in band 1. The trace is blanked both above and below the frequency ranges selected on the R. F. RANGE (GHz) switch to

prevent false interpretation of the noise level as being lack of signal. At these points the local oscillator has either lost power or stopped oscillating and thus the analyzer could not display proper signals. The blanking may be overridden by an internal control if the user so desires to permit the fullest operation, although this could potentially cause some readout discrepancies.

Returning the digital readout to 3000 MHz and selecting band 3 [3.3 - 8.3 position on the R.F. RANGE (GHz) switch], the baseline should shift approximately 8 dB upward indicating the loss in sensitivity due to second harmonic mixing. The baseline shifting is caused by gain compensation in the analyzer to provide amplitude calibration over the whole frequency range. In this band the SCAN WIDTH/cm switch should be set at 500 MHz to display the whole frequency range. The center of the frequency will be 5800 MHz. Switching of the R.F. RANGE (GHz) switch to band 4 (5.4 - 12.4 position) and the SCAN WIDTH/cm switch to the 700 MHz position selects this whole band frequency with the center frequency at 8900 MHz. The baseline again shifts approximately 8 dB and should now be at about the 60 dB line.

2-15. BLANKING AND FULL RANGE SELECT

Switching the R.F. RANGE (GHz) switch down to band 2 (1.8 - 4.0 position), which had been viewed earlier, should now greatly drecrease the horizontal display on the screen since the SCAN WIDTH/cm switch is in the 700 MHz position. The regions outside of the baseline have been blanked since the oscillator cannot perform over this great area. Changing the SCAN WIDTH/cm switch to 200 MHz restores the full sweep presentation. At this point if the FULL RANGE switch concentric to the R.F. RANGE (GHz) switch is turned to the ON position, the same 2 to 4 GHz presentation will occur, but with negative marker at the center of the screen. This marker indicates the location of the TUNING control and will follow it as it is changed. The digital readout also indicates the frequency of the marker and permits signals to be identified anywhere within the band. By rotating the FULL RANGE

switch to the OFF position, the area around the tuning marker will be expanded to the width selected at the SCAN WIDTH/cm switch. This function is not a truly precise one and the center frequency will be within 30 MHz of that desired.

2-16. WIDE BAND DISPLAY

Selection of band 5, on the R. F. RANGE (GHz) switch (the 2 - 12 position), presents the full display of this frequency range. The display will consist of a stepped baseline at the band 2 sensitivity for the first 2 cm, the band 3 sensitivity for the next 4 cm, and the band 4 sensitivity for the last 4 cm. Each cm is 1 GHz in frequency and the stepping permits the amplitude calibration of the full frequency range. Overlap occurs at each crossover point to prevent loss of signal. In this mode most of the front panel controls are deactivated and the display is a fixed time display with 1 MHz IF bandwidth automatically selected, and overriding by different bandwidths prevented. The frequency readout shoud be 7000 MHz and indicates the center of the frequency band.

2-17. VIDEO DISPLAY

The controls on the display module are very easy to check. SCALE illumination controls the intensity of the graticule lighting, the fully clockwise position giving greatest intensity. The INTENSITY control adjusts the intensity of the trace on the screen and clockwise rotation again gives full intensity. The cathode ray tube and its power supply do go through a warmup period which usually causes a bright intensity for the first half hour of operation and then a controlled operation from then on. The focus control is affected by the astigmatism and geometry controls and are located internal to the unit. The BASELINE control clips the level at which the baseline is blanked. This control permits photography without excessive blooming on the screen. The concentric CONTRAST control returns some of the clipped baseline to permit optimum photography to occur.

SECTION III
PERIODIC SYSTEM CHECKS

3-1. GENERAL

This section contains system checks and alignments to be performed every six months or 1000 hours of use, whichever occurs first, or whenever a major repair or replacement has been performed.

3-2. POWER SUPPLY AND REGULATOR ADJUSTMENT

a. Using a digital voltmeter, check the output voltages of power supply (230426). These voltages should be +18.2, -18.0, +24, and +5 Vdc and are adjustable by their respective pots on the power supply.

b. Connect a digital voltmeter between the anode of CR7 on the preamplifier J4 board (230480) and chassis ground. Adjust R31 on preamplifier board (230480) (Figure 3-1) for a -6 ±0.005 Vdc reading.

c. Connect a digital voltmeter between the cathode of CR6 on the preamplifier J4 board (230480) and chassis ground. Adjust R34 on the preamplifier J4 board (230480) (Figure 3-1) for a +6 ±0.005 Vdc reading.

3-3. BAND 1 ALIGNMENT

a. Connect an AILTECH 707-90 Comb Generator or equivalent to the R. F. INPUT jack of the AILTECH 707.

b. Set the front panel switches and controls to the following positions:

R. F. RANGE (GHz)	0.001 - 2.0
R. F. ATTEN (dB)	20
I. F. ATTEN (dB)	10
SCAN WIDTH/cm	200 MHz

BANDWIDTHS (kHz)	
I. F.	AUTO
VIDEO	AUTO
AMPLITUDE RANGE	10 LOG (dB/cm)
SCAN MODE	AUTO
BASELINE (outer knob)	Maximum counterclockwise
FULL RANGE (R. F. RANGE center knob)	OFF
SIGNAL CENTER	Centered
TUNING	Center (digital readout should read 1000 MHz)

c. Twenty comb lines should appear on screen. If not, adjust R50 (Figure 3-2) (band 1 filter offset) on YIG offset board (part of R. F. RANGE (GHz) switch 230334) until 20 comb lines appear. Two settings are possible: the most counterclockwise setting is correct.

d. Adjust HOR POS control on front panel until trace begins on first graticule line (overlap on right side is normal.)

e. Set SCAN WIDTH/cm switch to 100 MHz. Adjust R24 (display gain) on sweep generator J1 board (230216) (Figure 3-3) so that each 100-MHz comb line falls on a graticule line. (Some adjustment of TUNING control will be necessary to cause first comb line to fall on first graticule line.)

f. Disconnect AILTECH 707-90 Comb Generator. Adjust TUNING control to approximately 0 MHz until band 1 zero beat frequency signal (refer to paragraph 2-7) is in center of screen. Set SCAN WIDTH/cm switch to 10 MHz and recenter. Set SCAN WIDTH/cm switch to 200 MHz; zero beat should stay in center of screen. If not, adjust R22 (level shift adjust) on sweep generator J1 board (230216) (Figure 3-3).

NOTE

Adjust R22 only when the SCAN WIDTH/cm switch is in the 200 MHz position.

Turn TUNING control to center zero beat when at 10 MHz/cm. Repeat procedure until signal remains centered when SCAN WIDTH/cm switch is rotated.

g. Adjust R18 (balance) on preamplifier J4 board (230480) (Figure 3-1) until there is no baseline movement when the AMPLITUDE RANGE switch is rotated between the 2, 5, and 10 positions with the I. F. ATTEN (dB) switch set to 100 dB. Return the I. F. ATTEN (dB) switch to 10 dB after alignment.

h. Adjust R32 (log gain) on preamplifier J4 board (230480) (Figure 3-1) until it is approximately five turns from maximum counterclockwise position. This should positon R32 such that the display is properly calibrated, that is, the display varies linearly with the setting of the I. F. ATTEN (dB) switch. It may be necessary to vary R32 slightly clockwise to achieve this.

i. Turn TUNING control to center of band (1000 MHz) and connect the comb source (AILTECH 707-90 Comb Generator). Ground center tap (pin 2) of tuning pot R1 on tuner assembly (230275) with a clip lead (Figure 3-4). The digital readout should indicate 1000 MHz. If not, adjust R69 (band 1 slope) (Figure 3-2) on digital display board J3 (230335) (part of R. F. RANGE (GHz) switch 230334) for the proper reading.

j. Locate 1000-MHz comb line by counting 10 lines up from the zero beat line. (Zero beat line does not change amplitude when R. F. ATTEN (dB) switch is rotated.) The 1000-MHz line should fall in center of screen. If not, adjust R35 (band 1 VCO offset) (Figure 3-2) on YIG offset board (230339) [part of R. F. RANGE (GHz) switch 230334]. Adjust R50 (Figure 3-2) on YIG offset board (230339) [part of R. F. RANGE (GHz) switch 230334] for maximum amplitude.

k. Remove clip lead from TUNING control and set zero beat signal to center of screen at 10 MHz/cm. Adjust R58 (band 1 gain) (Figure 3-2) on

digital display board 230335 [part of R. F. RANGE (GHz) switch 230334] until digital readout indicates 0 MHz. Set SCAN WIDTH/cm switch to 200 MHz and R. F. ATTEN (dB) switch to 20. Adjust R21 (band 2 mixer bias) on wide range sweep generator J2 board (230219) (Figure 3-3) until all signals are maximized.

3-4. BAND 2 ALIGNMENT

a. Set R. F. RANGE (GHz) switch to 1.8 - 4.0, SCAN WIDTH/cm switch to 200 MHz, and TUNING control to 3000 MHz (as read on digital readout).

b. Adjust R32 and R47 (Figure 3-2) on YIG offset board (230339) and R20 (Figure 3-2) on YIG gains board (230337) until 20 scan lines appear on the screen. [Both boards are part of R. F. RANGE (GHz) switch 230334.]

NOTE

There are two responses: one with the YIG VCO on low side of filter (incorrect) and one with the YIG VCO on high side of filter (correct). Clockwise turning of all offset pots increases frequency, therefore, the most clockwise response of R32 to VCO offset and the most counterclockwise response of R47 YIG filter offset is correct.

c. Ground center tap (pin 2) of TUNING control R1 on tuner assembly (230275) (Figure 3-4). Digital readout should indicate 3000 MHz; if not, adjust R66 on digital display board (230335) [part of R. F. RANGE (GHz) switch 230334].

d. Locate 3000-MHz line (center frequency, band 2) with signal generator or frequency meter. Adjust R32 and R47 (Figure 3-2) on YIG offset board (230339) [part of R. F. RANGE (GHz) switch 230334] to move this line to center of screen as SCAN WIDTH/cm is decreased to 10 MHz.

e. At 200 MHz/cm, adjust R20 (Figure 3-2) on YIG gain board (230337) until tracking occurs on first and last graticule lines. Adjust R47 and R20 (Figure 3-2) for best tracking. These controls are optimized when best response occurs with SIGNAL CENTER control at the center of its range.

f. Remove clip lead from TUNING control and ensure that 3000 MHz is still on center of screen; adjust TUNING control if not. Then, with SCAN WIDTH/cm switch at 30 MHz, rotate TUNING control slowly counterclockwise and count 100 MHz comb lines until the 2000-MHz line (band 2 lower calibration point) is identified. Center this line at 10 MHz/cm and adjust R56 (Figure 3-2) on digital display board (230335) until digital readout indicates 2000 MHz.

3-5. BAND 3 ALIGNMENT

a. Set R. F. RANGE (GHz) switch to 3.3 - 8.3 GHz, SCAN WIDTH/cm switch to 200 MHz, TUNING control to 5800 MHz (as read on digital readout), and R. F. ATTEN (dB) switch to 0.

b. Adjust R29 and R44 (Figure 3-2) on YIG offset board (230339) and R17 on YIG gains board (230337) until 20 scan lines appear on screen. There are two responses: one with the YIG VCO on the low side of the filter (incorrect) and one with the YIG VCO on the high side of the filter (correct). Clockwise turning of all offset pots increases frequency, therefore, the most clockwise response of R29 and the most counterclockwise response of R44 is correct.

c. Ground center tap (pin 2) of TUNING control R1 on tuner assembly (230275) (Figure 3-4). Digital readout should indicate 5800 MHz, if not, adjust R63 (Figure 3-2) on digital display board (230335).

d. Locate 5800-MHz line (center frequency, band 3) with signal generator or frequency meter. Adjust R29 and R44 (Figure 3-2) on YIG offset board (230339) to move this line to center of screen as SCAN WIDTH/cm switch is decreased to 10 MHz.

e. Set SCAN WIDTH/cm switch to 500 MHz and adjust R17 (Figure 3-2) on YIG gains board (230337) until tracking occurs on first and last graticule lines. Adjust R44 and R17 for best tracking. These controls are optimized when best response occurs with SIGNAL CENTER control at the center of its range.

f. Remove clip lead from TUNING control and ensure that 5800 MHz is still on center of screen; adjust TUNING control if not. Then, with SCAN WIDTH/cm switch at 30 MHz, rotate TUNING control slowly counterclockwise and count 100 MHz comb lines until the 4800 MHz line (band 3 lower calibration point) is identified. Center this line at 10 MHz/cm and adjust R54 (Figure 3-2) on digital display board (230335) until digital readout indicates 4800 MHz. Set SCAN WIDTH/cm switch to 200 MHz and R.F. ATTEN (dB) switch to 20.

g. Adjust R25 (Figure 3-3) on wide range sweep generator J2 board (230219) until all signals are maximized.

3-6. BAND 4 ALIGNMENT

a. Set R.F. RANGE (GHz) switch to 5.4 - 12.4, SCAN WIDTH/cm switch to 200 MHz, TUNING control to 8900 MHz (as read on digital readout), and R.F. ATTEN (dB) switch to 0.

b. Adjust R26 and R41 (Figure 3-2) on YIG offset board (230339) and R14 on YIG gains board (230337) until 20 scan lines appear on screen. There are two responses: one with the YIG VCO on the low side of the filter (incorrect) and one with the YIG VCO on the high side of the filter (correct). Clockwise turning of all offset pots increases frequency, therefore, the most clockwise response of R26 and the most counterclockwise response of R41 is correct.

c. Ground center tap pin 2 of TUNING control R1 on tuner assembly (230275) (Figure 3-4). Digital readout should indicate 8900 MHz, if not, adjust R60 (Figure 3-2) on digital display board 230335.

d. Locate 8900-MHz line (center frequency, band 4) with signal generator or frequency meter. Adjust R26 and R41 (Figure 3-2) on YIG offset board (230339) to move this line to center of screen as SCAN WIDTH/cm switch is decreased to 10 MHz.

e. Set SCAN WIDTH/cm switch to 700 MHz and adjust R14 to YIG gains board (230337) until tracking occurs on first and last graticule lines. Rotate SIGNAL CENTER control to obtain maximum signal amplitude of comb lines at 10 MHz/cm and 200 MHz/cm positions. Adjust R41 and R14 (Figure 3-2) for best tracking. These controls are optimized when best response occurs with SIGNAL CENTER control at the center of its range.

f. Remove clip lead from TUNING control and ensure that 8900 MHz is still on center of screen; adjust TUNING control if not. Then, with SCAN WIDTH/cm switch at 30 MHz, rotate TUNING control slowly counterclockwise and count 100 MHz comb lines until the 7900-MHz line (band 4 lower calibration point) is identified. Center this line at 10 MHz/cm and adjust R52 (Figure 3-2) on digital display board (230335) until digital readout indicates 7900 MHz. Set SCAN WIDTH/cm switch to 200 MHz and R. F. ATTEN (dB) switch to 20.

g. Adjust R34 on wide range sweep generator J2 board (230219) until all signals are maximized.

3-7. END BAND LIMITS ADJUSTMENT

a. Set the front panel switches and controls to the following settings:

R. F. RANGE (GHz)	3.3 - 8.3
R. F. ATTEN (dB)	0
I. F. ATTEN (dB)	10
SCAN WIDTH/cm	200 MHz

BANDWIDTHS (kHz)	
I. F.	AUTO
VIDEO	AUTO
AMPLITUDE RANGE	10 LOG (dB/cm)
SCAN MODE	AUTO
BASELINE (outer knob)	Maximum counterclockwise
FULL RANGE [R. F. RANGE (GHz) center knob]	OFF
SIGNAL CENTER	Centered
TUNING	Digital readout should read 3300 MHz

b. Adjust R61 (Figure 3-3) on sweep generator J1 board (230216) to blank all signals below 3300 MHz.

c. Set the TUNING control for a digital readout of 8300 MHz. Adjust R60 (Figure 3-3) on sweep generator J1 board (230216) to blank all signals above 8300 MHz.

3-8. FULL RANGE MARKER ALIGNMENT

a. Set the front panel switches and controls to the following settings:

R. F. RANGE (GHz)	1.8 - 4.0
R. F. ATTEN (dB)	0
I. F. ATTEN (dB)	10
SCAN WIDTH/cm	200 MHz
BANDWIDTHS (kHz)	
I. F.	AUTO
VIDEO	AUTO
AMPLITUDE RANGE	10 LOG (dB/cm)
SCAN MODE	AUTO
BASELINE (outer knob)	Maximum counterclockwise

FULL RANGE [R. F. RANGE (GHz) center knob]	ON
SIGNAL CENTER	Centered
TUNING	Digital readout should read 3000 MHz

b. Marker should be sitting in center of 3000 MHz line. Turn TUNING control so that the marker moves upward in frequency (to the right) six comb lines. The digital display should read 3600 MHz. Adjust R55 (Figure 3-3) on sweep generator J1 board (230216) so that the marker sits in the center of the 3600-MHz comb lines. Turn FULL RANGE switch to the OFF position.

3-9. LINEAR ADJUSTMENT

a. Set the front panel switches and controls to the following settings:

R. F. RANGE (GHz)	1.8 - 4.0
R. F. ATTEN (dB)	0
I. F. ATTEN (dB)	As required
SCAN WIDTH/cm	10 MHz
BANDWIDTHS (kHz)	
I. F.	AUTO
VIDEO	AUTO
AMPLITUDE RANGE	2 dB/cm
SCAN MODE	AUTO
BASELINE (outer knob)	Maximum counterclockwise
FULL RANGE [R. F. RANGE (GHz) center knob]	OFF
SIGNAL CENTER	Centered
TUNING	Digital readout should read 3000 MHz

b. Set I. F. ATTEN (dB) switch so that the amplitude of the 3000-MHz comb line covers the full screen. Turn AMPLITUDE RANGE switch to the LIN position. Adjust R46, R37, and R38 on preamplifier board (230480) (Figure 3-1) so that the absolute amplitude of the signal is the same in LIN as in the 2 dB/cm position and that an increase of 10 dB in IF attenuation in the LIN position will cause the signal to drop to the 70 dB graticule on the CRT of the AILTECH 707.

3-10. WIDE RANGE SWEEP ALIGNMENT

NOTE

If the wide range sweep generator is close to alignment, steps a, b, and c may be omitted.

a. Connect the scope probe to the junction of R15 and R16 on YIG driver J18 board (230547). Adjust the oscilloscope for a dc response of 1 V/cm and 0 volt at the top of the screen. Set R. F. RANGE (GHz) switch to 5.4 - 12.4 and SCAN WIDTH/cm switch to 700 MHz. Locate the 12.0 GHz line with a frequency meter and turn the TUNING control until it is centered on the graticule. Keep the 12.0 GHz line centered while lowering the SCAN WIDTH/cm switch to 3 MHz. Note the position of the trace on the oscilloscope and mark the position with a grease pencil. Occasionally check that 0 volt on the oscilloscope is at the top of the screen.

b. Set R. F. RANGE (GHz) switch to 1.8 - 4.0 and SCAN WIDTH/cm switch to 200 MHz. Locate the 2.0 GHz line with a frequency meter and turn the TUNING control until it is centered on the screen. Keep the 2.0 GHz line centered while lowering the SCAN WIDTH/cm switch to 3 MHz. Note the position of the trace on the oscilloscope and mark the position with a grease pencil.

c. Set R. F. RANGE (GHz) switch to 2 - 12 and adjust R56 (Figure 3-3) on wide range sweep generator J2 board (230219) until the trace on the oscilloscope goes very slightly beyond the two grease pencil markings. Also adjust R38 (Figure 3-2) on YIG offset board (230339) [part of R. F. RANGE (GHz) switch 230334] until the trace on the oscilloscope is centered about the grease pencil markings.

d. Adjust R57 (Figure 3-3) on wide range sweep generator J2 board (230219) until the trace extends from the first to the last graticule line.

e. Adjust R23 (Figure 3-2) on YIG offset board (230359) [part of R. F. RANGE (GHz) switch 230334] until a trace is observed in the band 3 (4 - 8 GHz) segment of the wide band display. (Usually two traces are observed.)

f. Adjust R77 (Figure 3-3) on wide range sweep generator J2 board (230219) until the trace fills the center segment with approximately 40 comb lines. Turn R23 (Figure 3-2) on YIG offset board (230339) [part of R. F. RANGE (GHz) switch 230334] clockwise and note if tracking reoccurs. The most clockwise position that obtains tracking is desired. This ensures that the oscillator is above the filter. The oscillator should not be adjusted again during wideband alignment.

g. Adjust R62 and R79 (Figure 3-3) on wide range sweep generator J2 board (230219) until approximately 20 lines appear in the band 2 (2 - 4 GHz) segment of the wideband display. Again adjust R62 to the most clockwise position for tracking.

h. Adjust R64 and R78 (Figure 3-3) on wide range sweep generator J2 board (230219) for approximately 40 lines in the band 4 (8 - 12 GHz) segment of the wideband display. Readjust R64 to the most clockwise position for tracking.

i. With appropriate frequency meters, confirm that the wideband range is sweeping from 2.0 to 12.0 GHz. If not, readjust R56 (Figure 3-3) on wide range sweep generator J2 board (230219) and R38 (Figure 3-2) on YIG offset board (230359) [part of R. F. RANGE (GHz) switch 230334] and repeat steps d through i.

3-11. CATHODE RAY ALIGNMENT

a. Allow 5-minute warmup time and then adjust HOR POS control on the front panel until trace begins on first graticule line. With IF attenuator set for 100 dB, adjust VERT POS control until trace is midway between the two lower, closely placed, graticule lines. Notice if trace is parallel to graticule lines. If a comb generator is available, slightly more accurate CRT alignment is possible.

b. If CRT requires rotation, set POWER switch to OFF and disconnect plug, loosen clamp on CRT base, and remove bezel, plastic graticule, and filter. Place one hand on CRT socket, and the other hand flat against glass of CRT face. Rotate CRT in desired direction being sure that CRT is kept as far forward as possible. Replace graticule against CRT, blue filter in front of graticule, and bezel in front of blue filter.

c. Recheck alignment as described in step a.

d. After complete warmup, check that intensity is slightly greater than desired for proper baseline clipper action when intensity control is rotated to maximum clockwise position.

3-12. SWEEP TIME VERIFICATION

a. Connect a TEKTRONIX 535 or equivalent oscilloscope to SWEEP OUT jack on the rear panel. Set SCAN MODE switch to AUTO, SCAN WIDTH/cm switch to 10 MHz, SCAN TIME/cm switch to 10 μsec, and R. F. RANGE (GHz) switch to 0.001 - 2.0. Measure the scan time for the following SCAN TIME/cm switch positions.

SCAN TIME/cm	Min	Max
10 μsec	90 μsec	110 μsec
100 μsec	900 μsec	1100 μsec
1000 μsec	9 msec	11 msec
3 msec	27 msec	33 msec
10 msec	90 msec	110 msec

b. Set the TUNING control for 1000 MHz center screen and the SCAN TIME/cm switch to 3 msec. Turn the SCAN TIME/cm switch to 1000 μsec (TIME DOMAIN). The baseline level should rise indicating that the AILTECH 707 is tuned to one of the 100-MHz comb signals.

3-13. SCAN MODE AND REAR PANEL CHECK

a. Turn the SCAN MODE switch through its range and verify that it is working properly.

b. Set the following switches on the front panel to the positions indicated:

SCAN WIDTH/cm	10 MHz
BANDWIDTHS (kHz)	
I.F.	AUTO
I.F. ATTEN (dB)	10
R.F. ATTEN (dB)	0
R.F. RANGE (GHz)	1.8 - 4.0
SCAN MODE	EXT TRIG

c. Connect the amplitude calibration output of the TEKTRONIX 535 oscilloscope, set at 1 V/cm, to the EXT TRIG input on the rear panel of the AILTECH 707. The comb lines should be present on the screen of the AILTECH 707.

d. Move the cable from the EXT TRIG connector to the EXT SWEEP connector. Set the SCAN WIDTH/cm switch to 30 MHz/cm and the SCAN MODE switch to EXT SWEEP. Two lines should be present on the analyzer.

e. Move the cable from the EXT SWEEP connector to the EXT BLANK connector on the rear panel of the AILTECH 707 and set the SCAN MODE switch to the AUTO position. The display on the AILTECH 707 should be three blanked signals.

f. Turn the oscilloscope amplitude calibration off and place the cable from the vertical input of the oscilloscope to the BLANK OUTPUT connector on the rear panel of the AILTECH 707. A pulse of approximately 3 volts in amplitude should be present.

g. Connect the VIDEO OUTPUT connector on the rear panel of the AILTECH 707 to the oscilloscope. With the SCAN MODE switch in the AUTO position, a signal should be present on the oscilloscope. Moving the SCAN MODE switch to VIDEO should remove the signal.

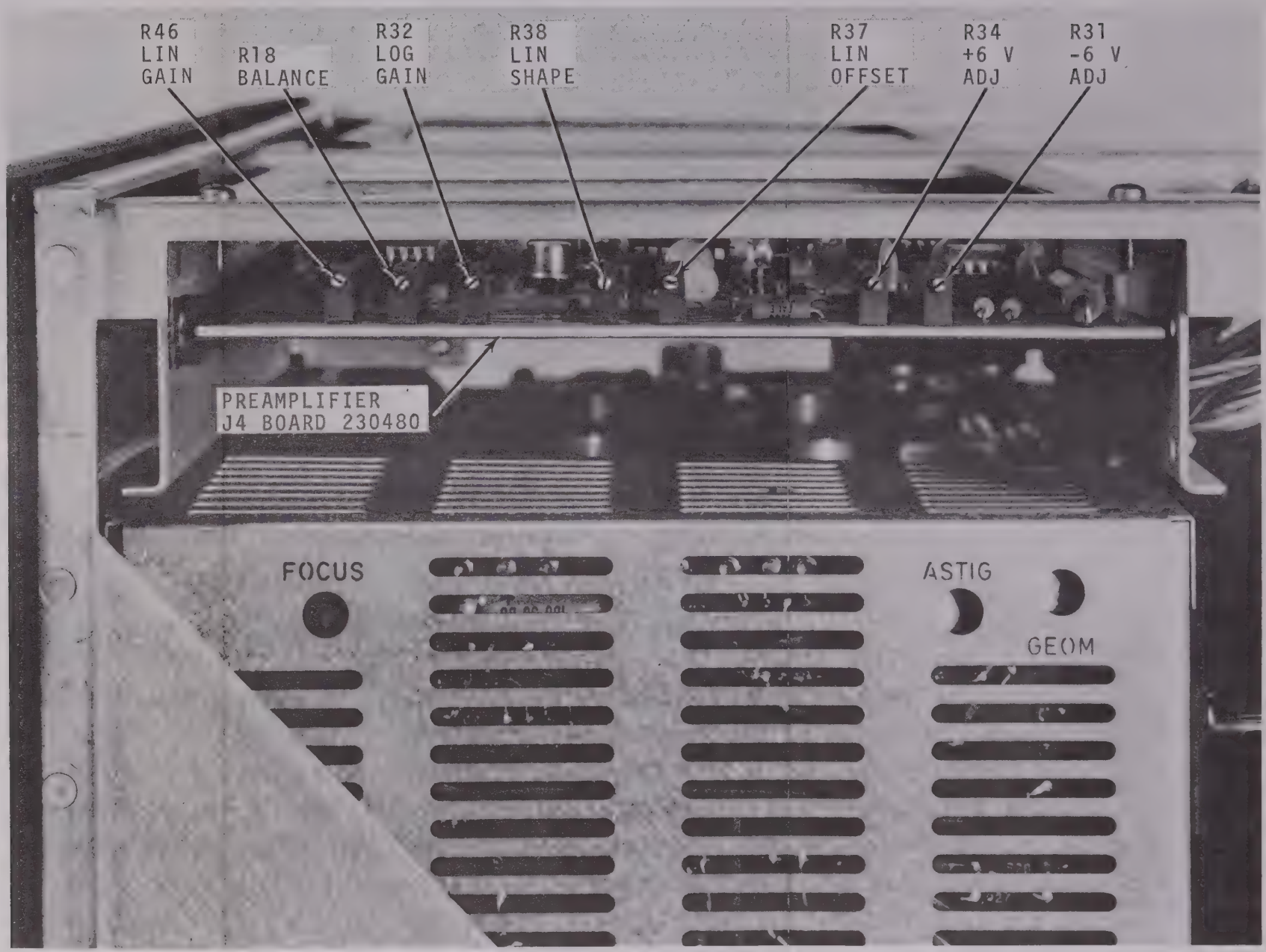

FIGURE 3-1. PREAMPLIFIER J4 BOARD (230480), ADJUSTMENT LOCATIONS

FIGURE 3-1

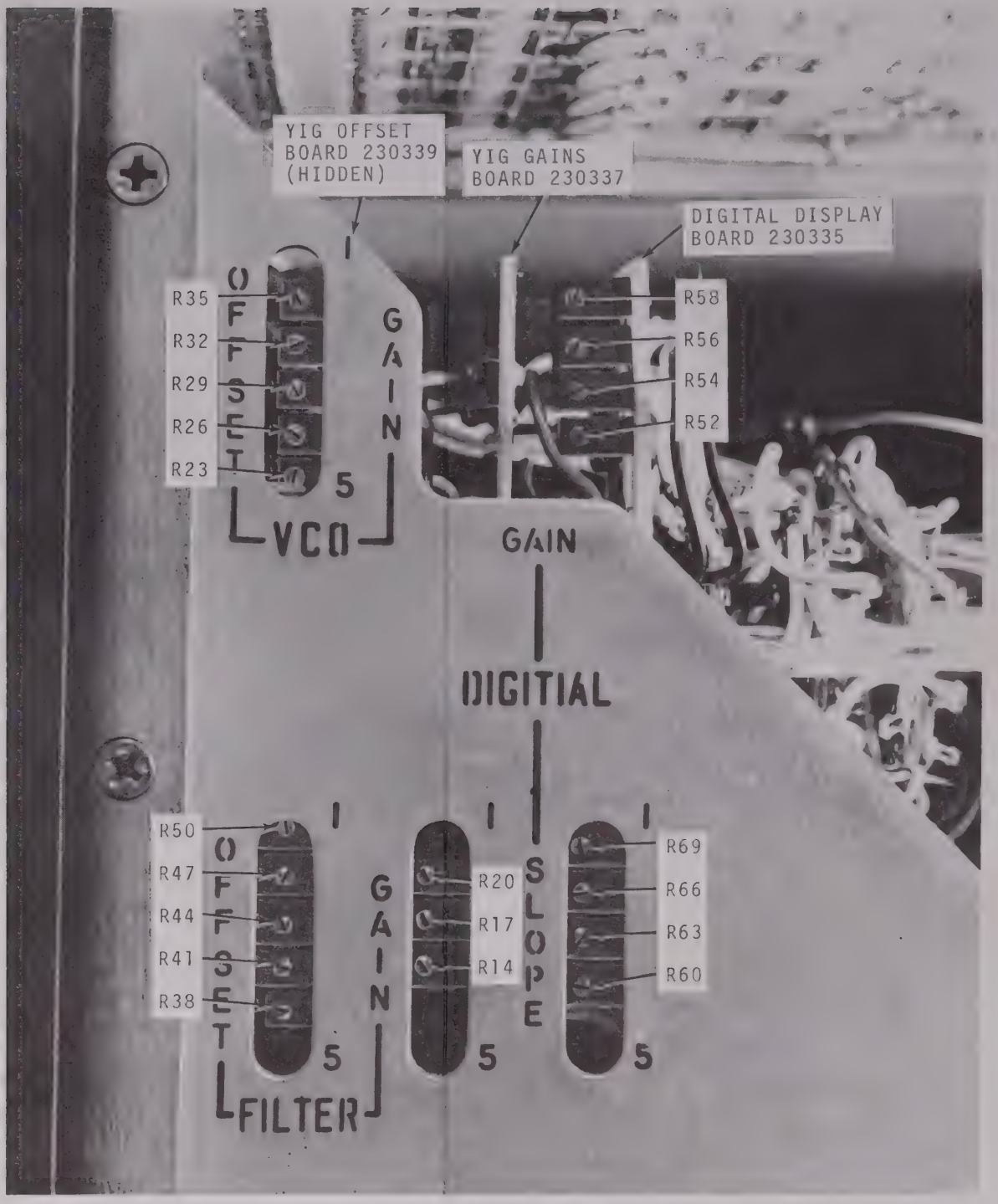

FIGURE 3-2. R.F. RANGE SWITCH (230334), ADJUSTMENT LOCATIONS

FIGURE 3-2

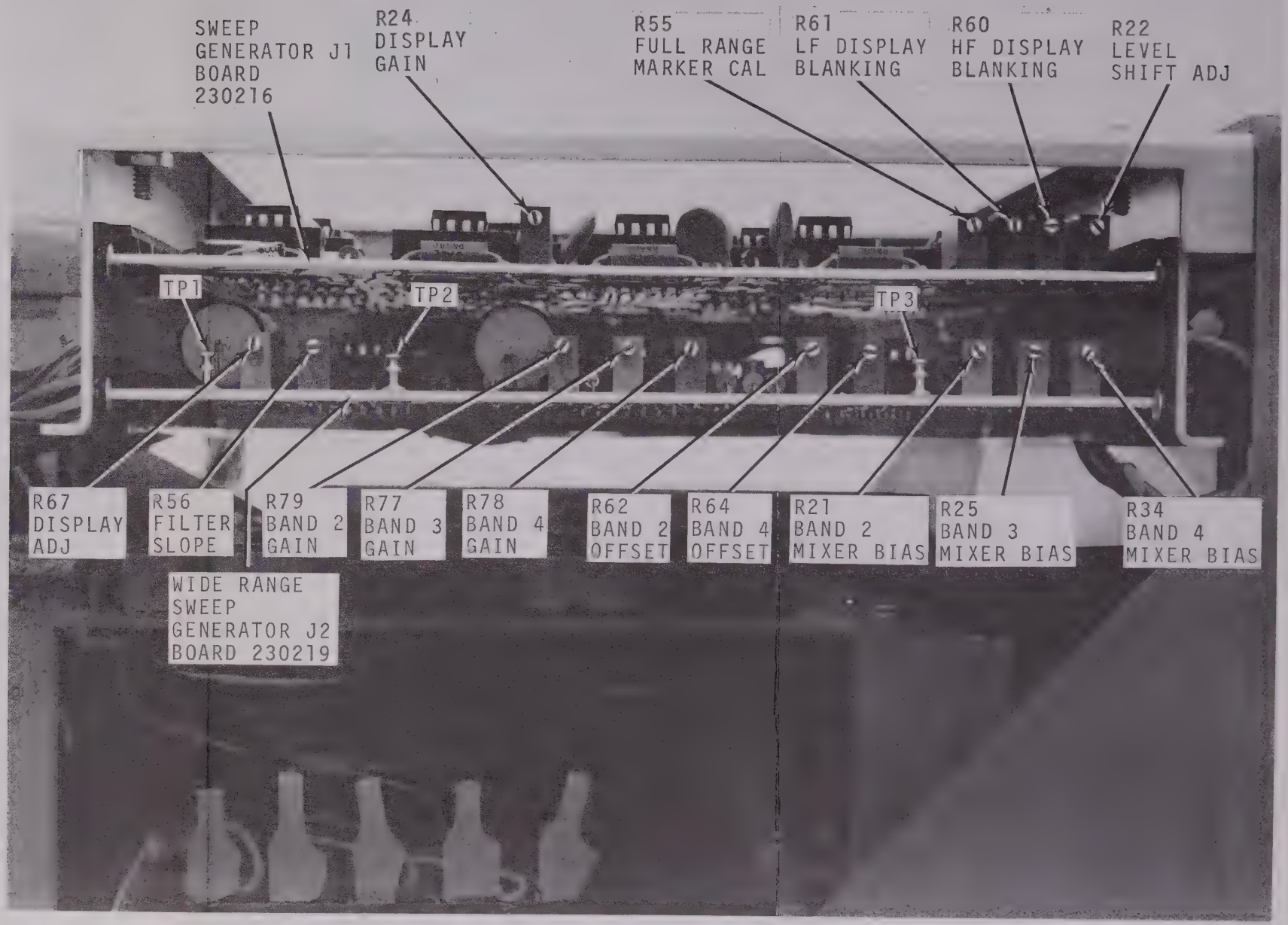

FIGURE 3-3. SWEEP GENERATOR J1 BOARD (230216) AND WIDE RANGE SWEEP GENERATOR J2 BOARD (230219), ADJUSTMENT LOCATIONS

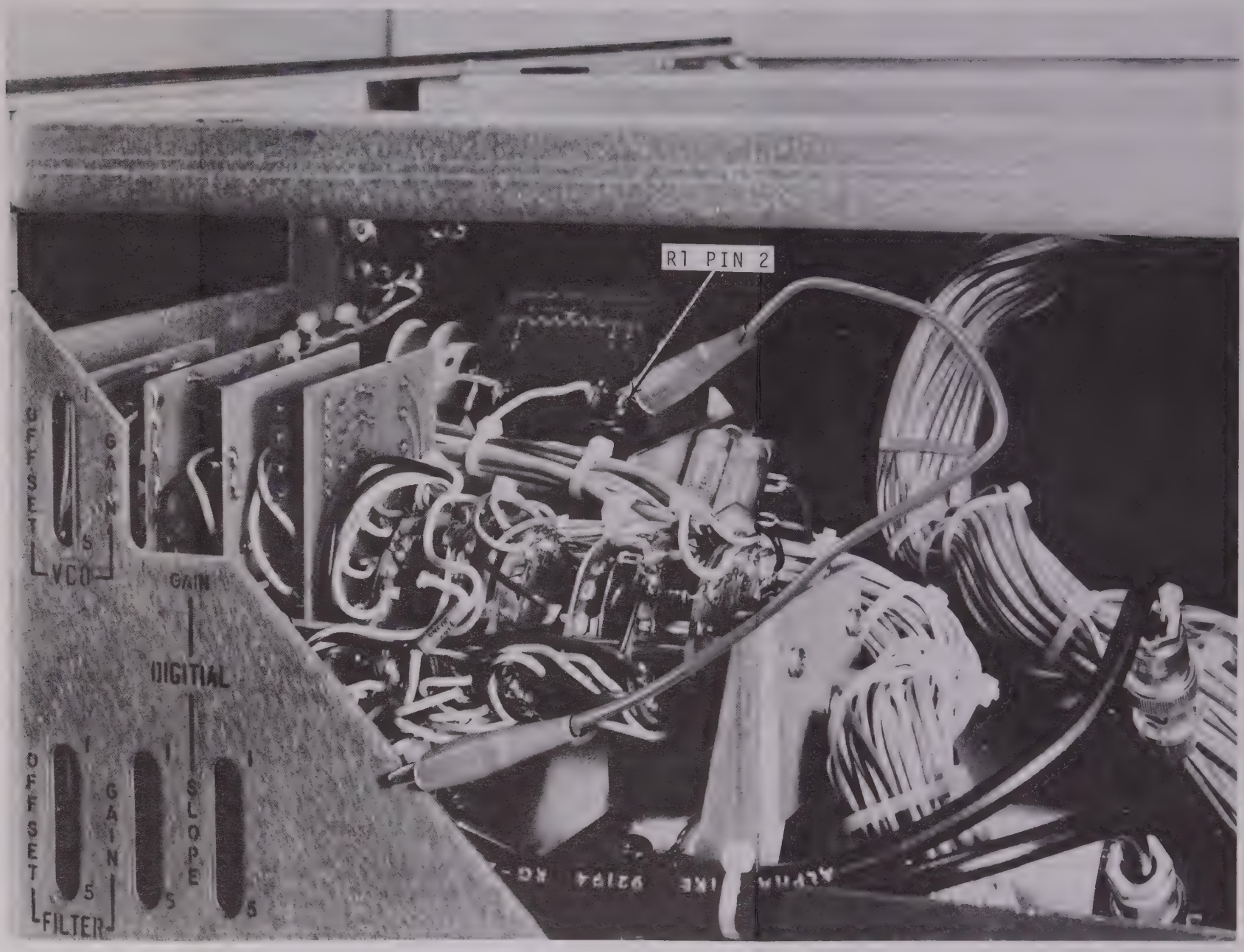

FIGURE 3-4. TUNING CONTROL CENTER TAP GROUNDING CONNECTION

FIGURE 3-4

SECTION IV
SUBSYSTEM PERFORMANCE VERIFICATION

4-1. FILTER RESPONSE VERIFICATION

Check to see that the I. F. BANDWIDTHS (kHz) AUTO select is choosing the proper filters. The proper filters are as follows:

Scan Width	Filter Chosen
700 through 10 MHz	1 MHz
3 MHz through 300 kHz	100 kHz
100 through 30 kHz	10 kHz
10 through 1 kHz	1 kHz

4-2. LCVCO ALIGNMENT

CAUTION

Do not perform this alignment if the LCVCO is working properly. This alignment is very critical, requires special equipment, and should not be attempted unless the LCVCO is known to be out of alignment or a malfunction of the LCVCO has occurred and a repair has been made.

a. Set the front panel switches and controls to the following positions:

R. F. RANGE (GHz)	1.8 - 4.0
R. F. ATTEN (dB)	0
I. F. ATTEN (dB)	0
SCAN TIME/cm	3 msec

BANDWIDTHS (kHz)	
I. F.	10
AMPLITUDE RANGE	10 LOG (dB/cm)
SCAN WIDTH/cm	1 MHz
SCAN MODE	AUTO
SIGNAL CENTER	Centered
FULL RANGE	OFF

b. Open RF deck for access to the LCVCO assembly (230543). Set R18 (SLOPE) and R17 (POSITION) on LCVCO shaper (230595) (part of LCVCO assembly 230543) to their center position. Adjust R12 (OFFSET) on LCVCO shaper (230595) for approximately -10.5 Vdc at SWEEP TEST point on the LCVCO shaper. Set R18 (SLOPE) and R17 (POSITION) fully counterclockwise.

c. Set SCAN WIDTH/cm switch to 300 kHz and set R22 (GAIN) on LCVCO shaper fully counterclockwise. Disconnect the cable to the 227 MHz filter (230189-1) input and apply 1-MHz comb lines by connecting a cable from an HP-8406 comb generator. Use the 20 - 200 MHz output. Observe the lines on the AILTECH 707 display. Adjust C2 (MAIN TUNING) on LCVCO oscillator II (230532) (part of LCVCO assembly 230543) to center lines about the 227-MHz filter response. Adjust C1 (FEEDBACK) and C4 (OUTPUT TUNING) on LCVCO oscillator II (230532) for best linearity (even spacing of comb lines). It may be necessary to readjust C2 (MAIN TUNING). Usually the spacing of the right side of the display will be expanded.

d. Adjust R22 (GAIN) so as to line up comb lines on as many graticule markers as possible. A minimum of six lines is required. Use R17 (POSITION)/SLOPE and R18 (SLOPE) for best linearity. These will reduce the expanded right side.

e. Identify the 227-MHz line by selecting 10-MHz comb lines (third line right of the 230-MHz line). Select 1-MHz comb lines again. Increase

R22 (GAIN) so that the line spacing is approximately 3.3 cm. Put the 227-MHz line to center by adjusting R12 (OFFSET). Adjust TUNING control and R22 (GAIN) to obtain exactly four 1-MHz lines for 10 cm with the SCAN WIDTH/cm switch set to 300 kHz.

f. Reset TUNING control to center and check to make sure that 227-MHz line is still at center. With SCAN WIDTH/cm switch set to 1 MHz, measure the power at 248-MHz test port on the LCVCO assembly; it should be 0 dBm, minimum.

4-3. PHASE LOCK ALIGNMENT PROCEDURE

Assuming the existence of a working 3.5 MHz limiting IF amplifier, a working comb generator and associated mixers, piping, and hardware in proper order, phase lock is aligned as follows.

a. Connect a Tektronix 502 oscilloscope using the differential dc input across the 10 ohms sampling resistor R44 located on the J18 YIG driver board (230547).

b. Set R36 on the J18 YIG driver board fully counterclockwise.

c. Set R32 on the J18 YIG driver board fully counterclockwise.

d. Put a 3-GHz S-band signal into the R. F. INPUT jack on the AILTECH 707. Move it to the center of the screen at the 1 MHz/cm dispersion and set the SCAN WIDTH/cm switch to 300 kHz/cm (the phase lock position).

e. Adjust R32 in a clockwise direction while moving the signal on the CRT display from left to right by using the SIGNAL CENTER control so that the voltage displacement on either side of 0 is slightly greater than 50 mV as seen on the Tektronix 502 oscilloscope. It should now be possible to adjust the SIGNAL CENTER control to skip the displayed signal from line to line on either side of center without depressing the SIGNAL CENTER control.

f. Now adjust R36 slowly in a clockwise direction until the signal cannot be moved when the SIGNAL CENTER control is turned to either extreme in the undepressed mode. The dc loop voltage as measured across the sampling resistor should not exceed 30 mV when the SIGNAL CENTER control is moved to either extreme in the undepressed mode. At this point, it should be possible to move the displayed signal only when the SIGNAL CENTER control is depressed; the displayed signal should not move when the SIGNAL CENTER control is undepressed.

g. At final setting, the measured voltage should be ±30 mV undepressed and ±50 mV when depressed.